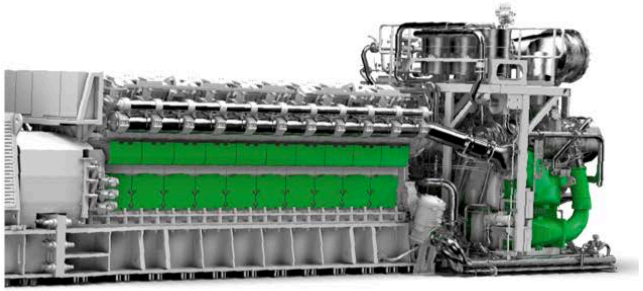
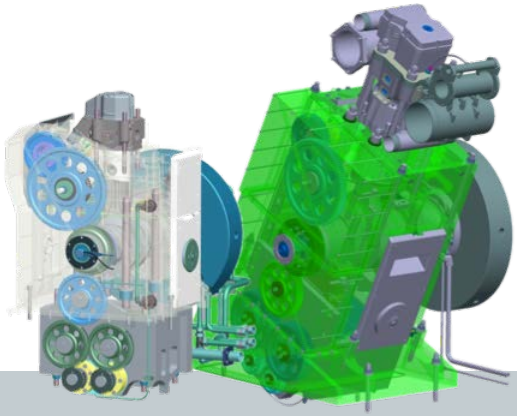
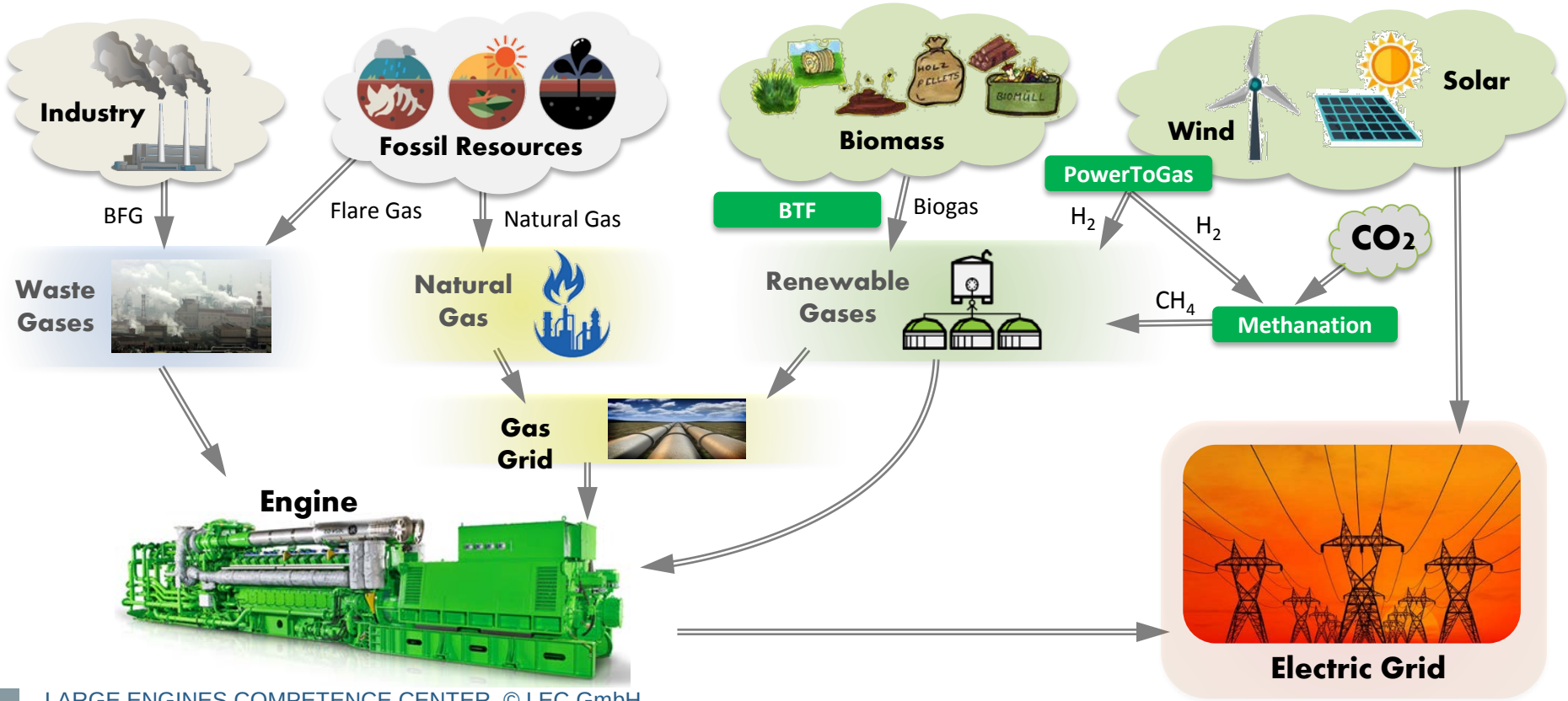
Large Engines Competence Center

Meeting the Challenges for Tomorrow's Power Generation Using Variable Intake Valve Train for Gas Engines

May 5th, 2017 • Jan Zelenka, Claudio Hoff

The role of the gas engine in power generation



Source:
Pirker G., Wimmer A., Sustainable Power Generation with Large Gas Engines, 11th sdewes, 2016

Content

- Challenges for tomorrow‘s gas engines
- Variable intake valve timing as a key technology
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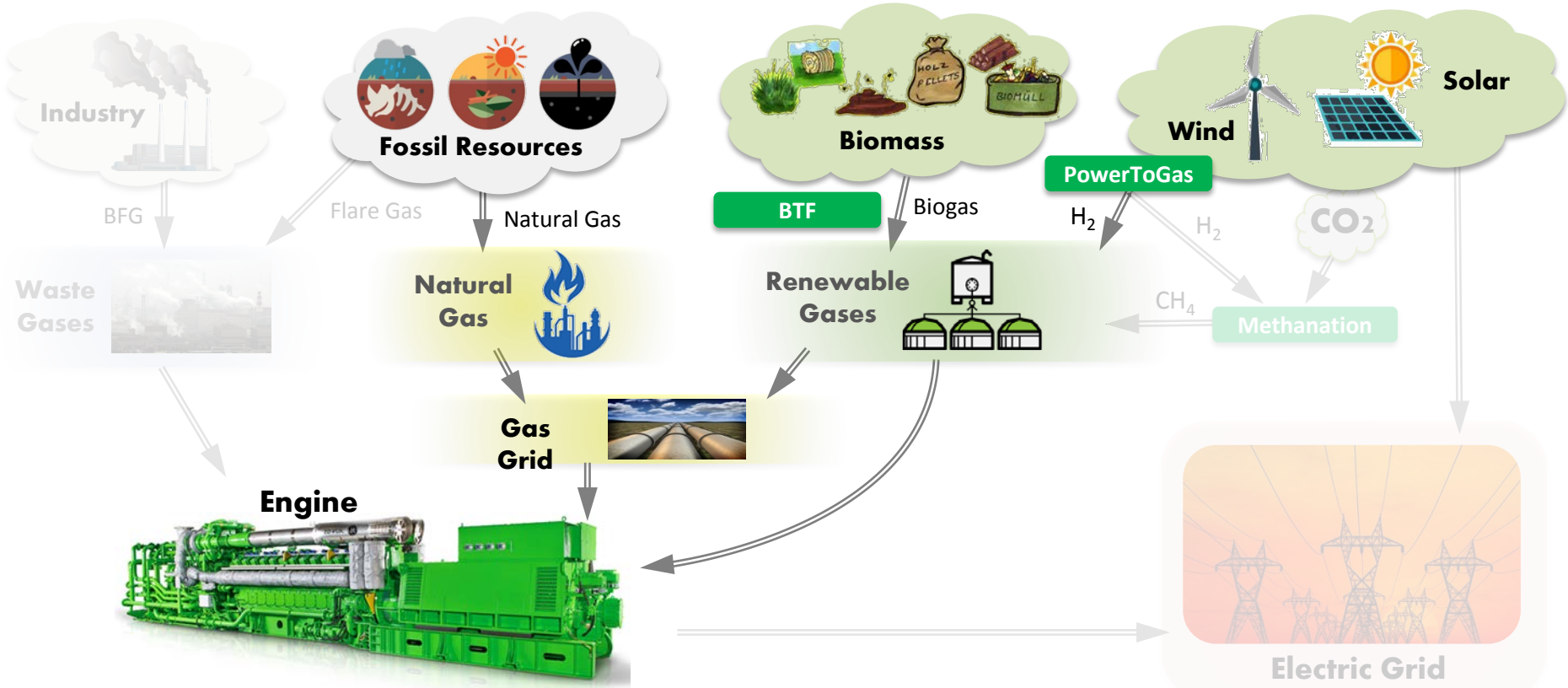
Challenges for tomorrow‘s gas engines
Gas quality issues



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Gas quality issues

- Harmonization process for European gas grid has started
  - European Association for the Streamlining of Energy Exchange
  - European Standard 16726

EASEE Gas

Parameter	Unit	min	max
Rel. density	m^3/m^3	0.555	0.700
Wobbe	MJ/m^3	48.6	56.9

EN 16726

Parameter	Unit	min	max
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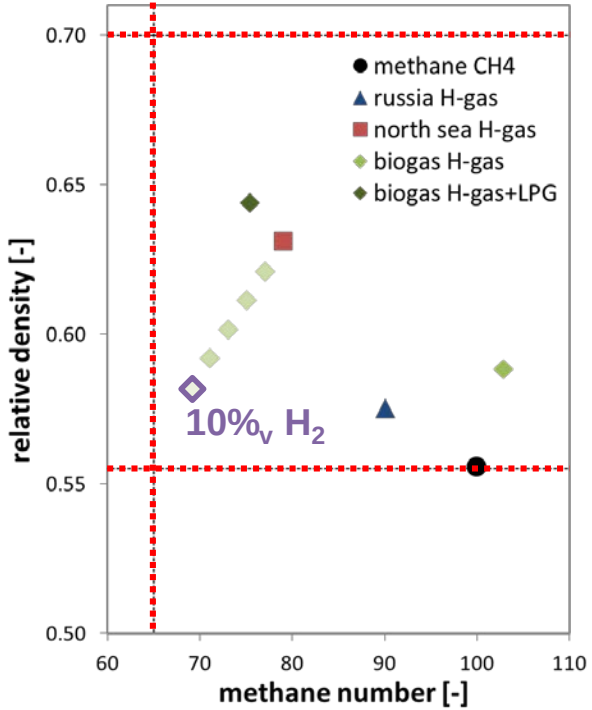
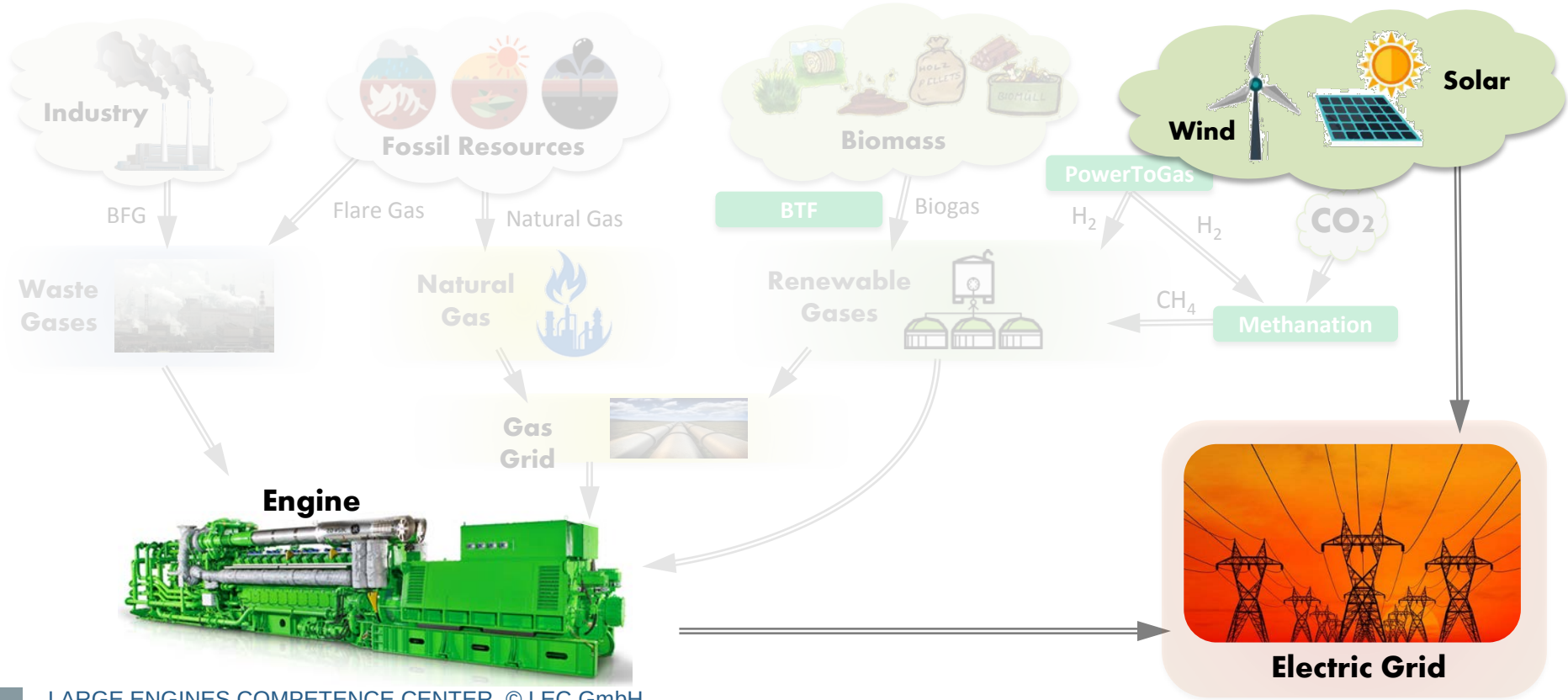


Challenges for tomorrow‘s gas engines
Volatile renewable energy



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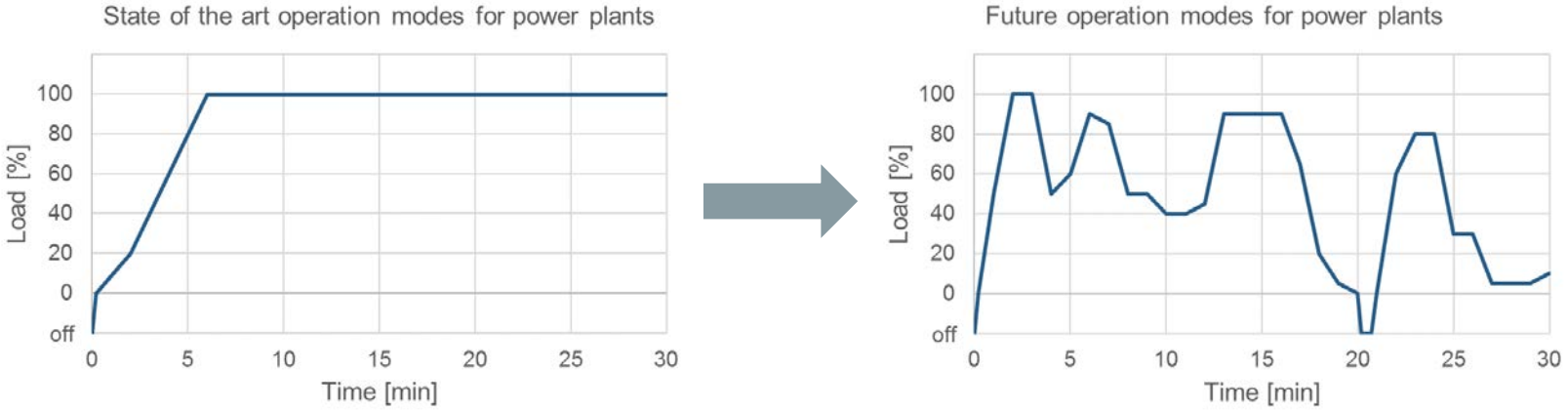
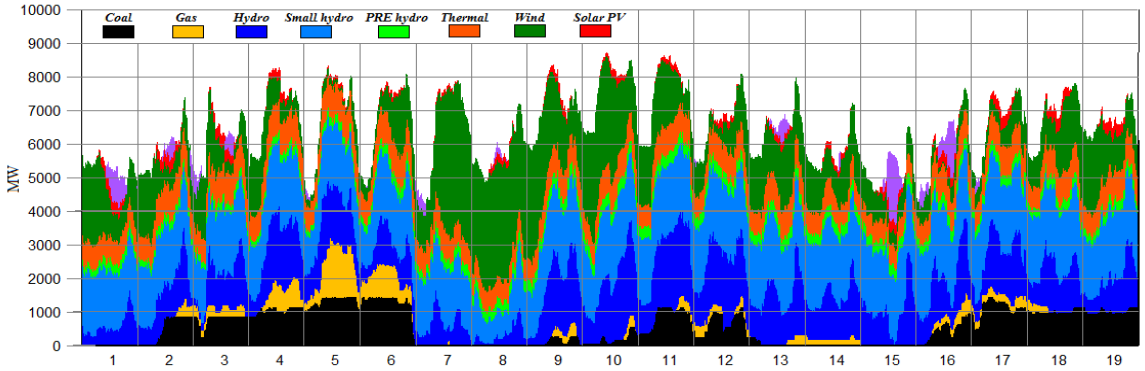
Challenges for tomorrow‘s gas engines
Volatile renewable energy – stabilize grid

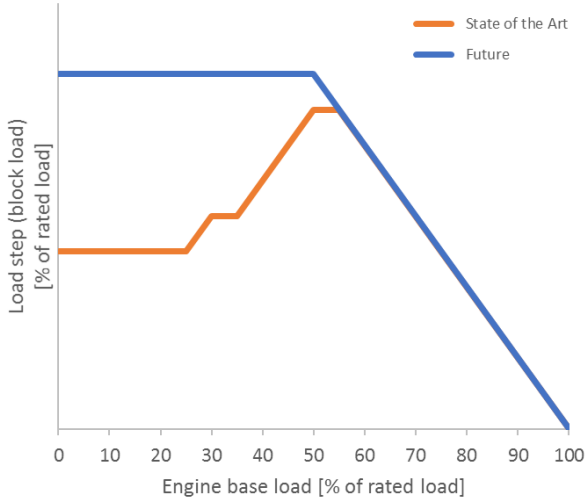




Source: Energy Matters, Did Portugal run for four days on renewables alone? (http://euanmearns.com/did-portugal-run-for-four-days-on-renewables-alone)

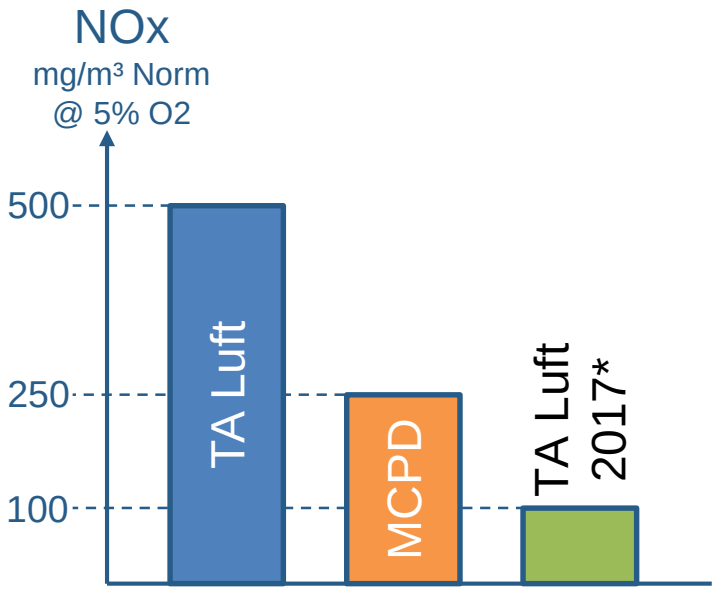
Transient response requirements

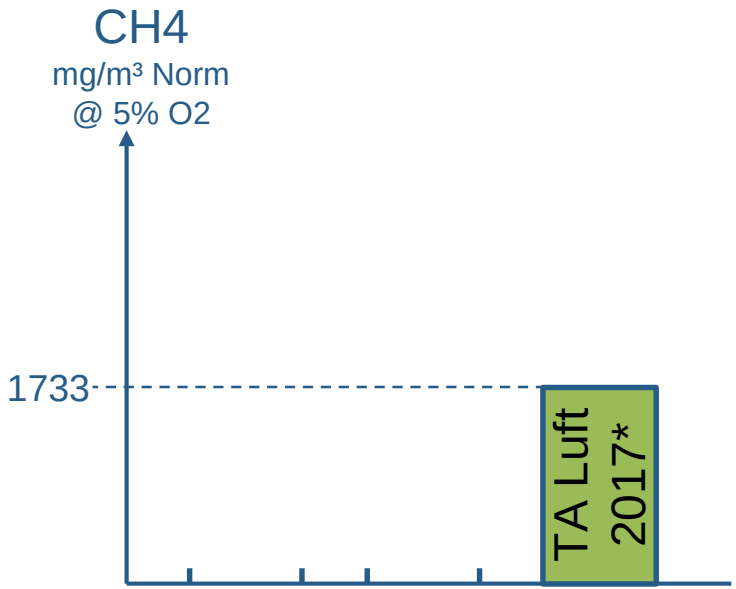
- ENTSO-E (Type C 1MW < P < 50MW)
  - 30 seconds to synchronize to the network
  - 10% loading in 4 seconds as spinning reserve
  - Stay connected to the network in a frequency band of ±10%
- ISO 8528-5 (Class G3)
  - Tolerated frequency drop 15%
  - Tolerated voltage drop 15%
  - Recovery time 3s



Emission limits

- Lower emission limits up ahead





* Proposal

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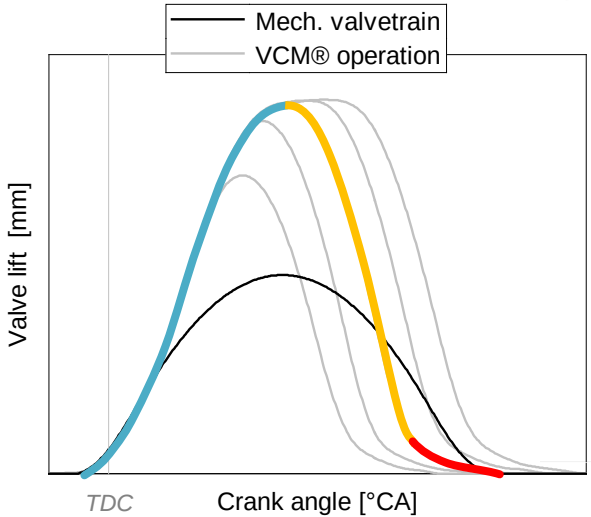
Variable intake valve timing as a key technology
ABB's Valve Control Management – VCM®

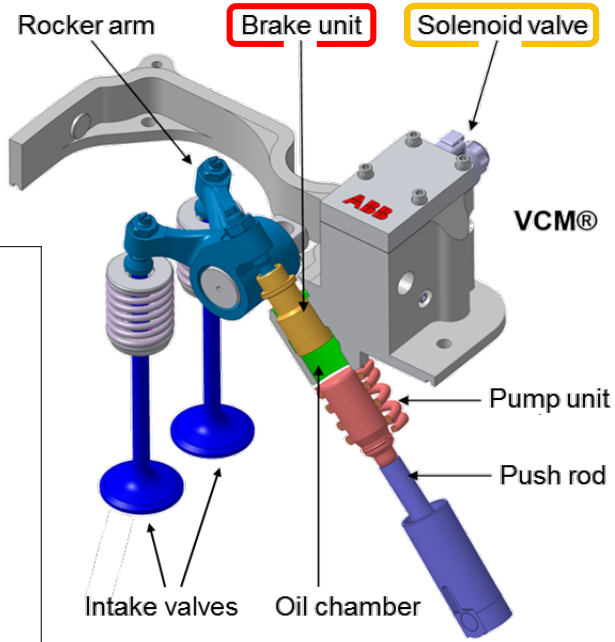
- Electro-hydraulic valve train system
- Variation of timing and lift of the intake valves

Operating principle:

1. Solenoid valve CLOSED
   - Valves follow cam profile
2. Solenoid valve OPEN
   - Oil pressure drops
   - Springs close the valve
3. Brake ramp
   - Hydraulic brake reduces seating velocity



Main components



Source:
Zelenka J., et al., Variable Intake Valve Train to Optimize the Performance of a Large Bore Gas Engine, ICEF2016-9358, 2016

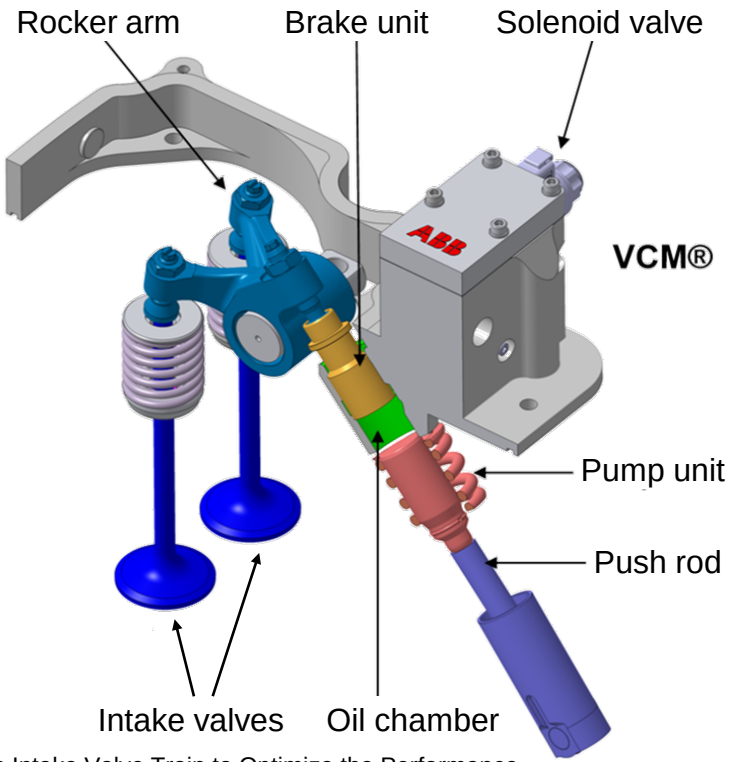
Variable intake valve timing as a key technology
ABB's Valve Control Management – VCM®

- Electro-hydraulic valve train system
- Variation of timing and lift of the intake valves

Advantages:

- Cylinder individual control
- Cycle-to-cycle variable adjustment of IVC
- Closes much faster than a mechanical valve train
- Soft landing due to hydraulic brake

Main components



IVC = Intake valve closing (angle)

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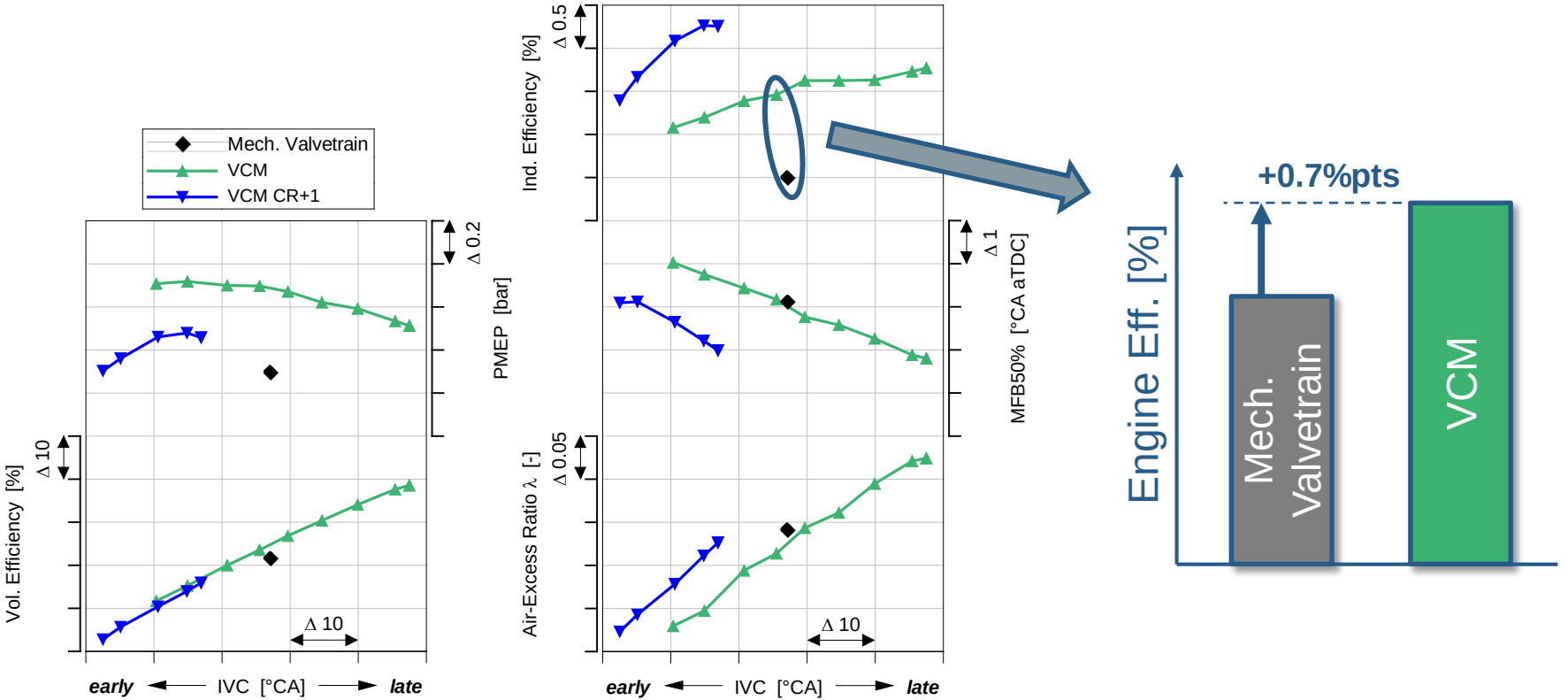
Zelenka J., et al., Variable Intake Valve Train to Optimize the Performance of a Large Bore Gas Engine, ICEF2016-9358, 2016

Variable intake valve timing as a key technology
Increased engine efficiency



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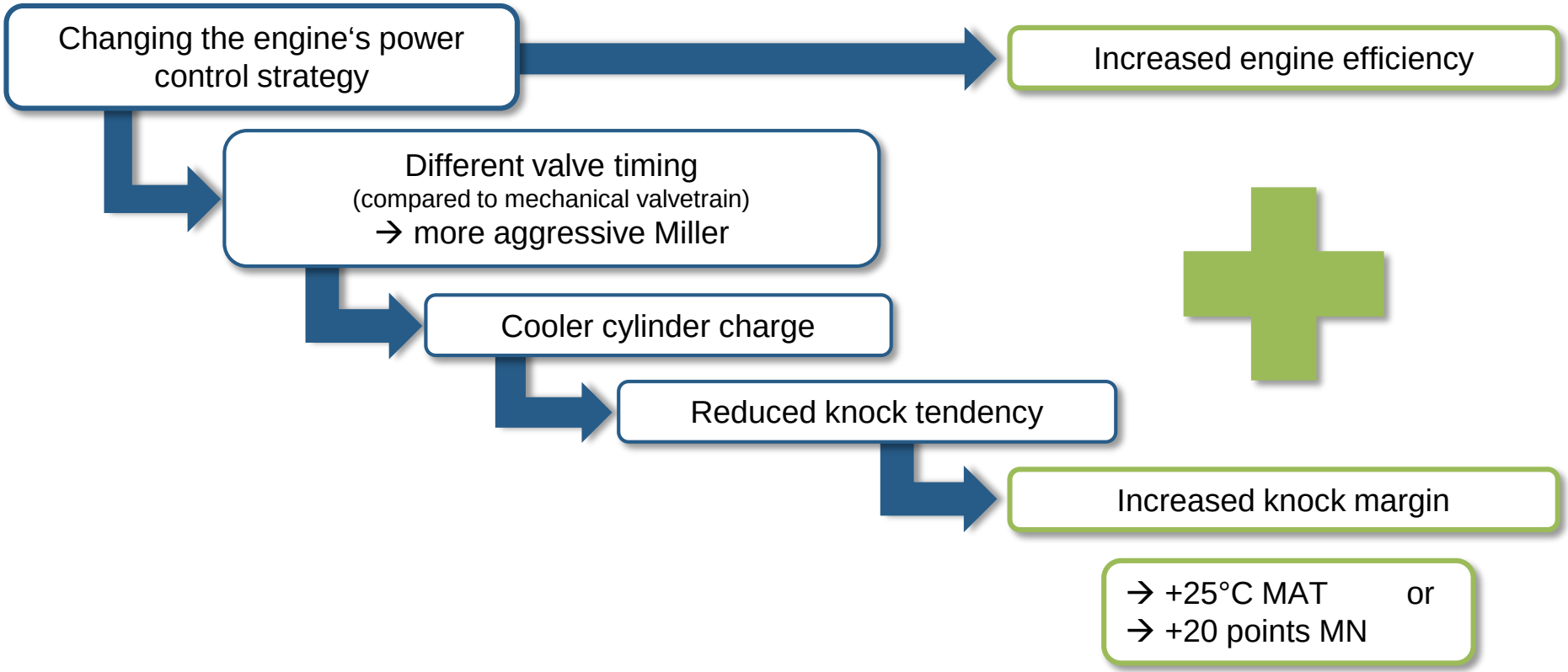
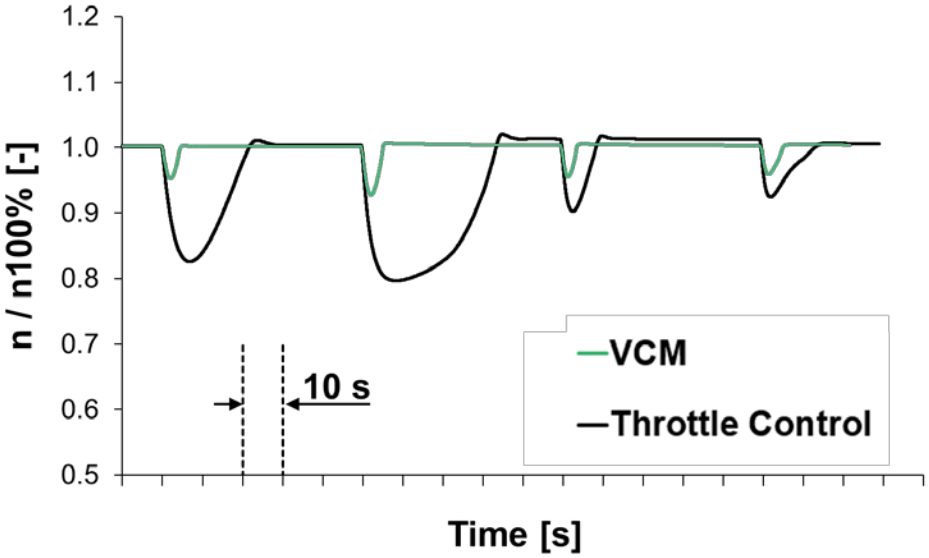
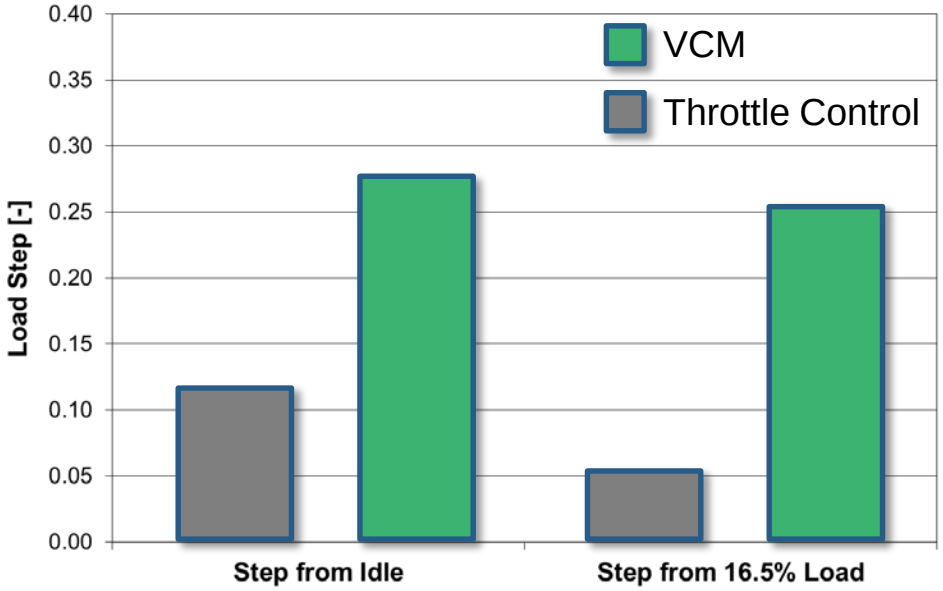
Variable intake valve timing as a key technology
Increased flexibility to boundary conditions



Source:
Zelenka J., et al., Valve Train Variability on a Large Bore Gas Engine – Increase in Efficiency and Expansion of the Operating Range, 21st Turbocharging Conference, Dresden, 2016

Variable intake valve timing as a key technology
Improved transient response





ISO 8528-5 Class G2

Source:
Christen, C., and Codan, E., Engine Control and Performance Enhancement with Variable Valve Train for Gas Engines, 16th Turbocharging Conference, Dresden, 2011

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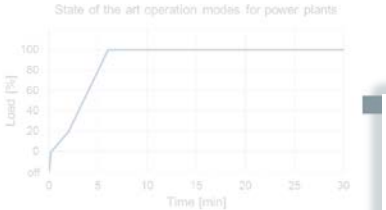

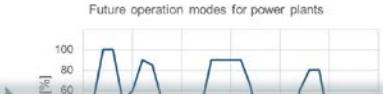

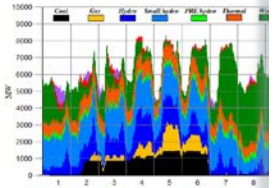

Source:
Energy
(http://eu

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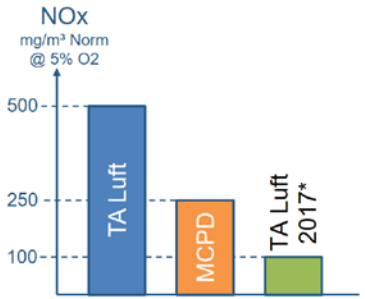

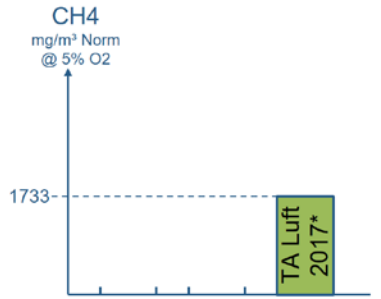

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VVT as a key technology

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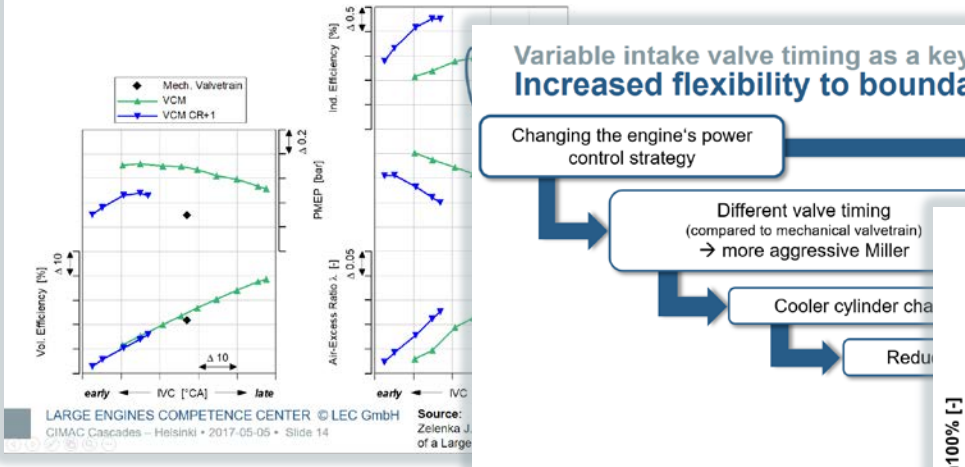
Increased engine efficiency



Source: Zelenka J. of a Large

Variable intake valve timing as a key technology
Increased flexibility to boundary conditions

Changing the engine's power control strategy → Increased engine efficiency

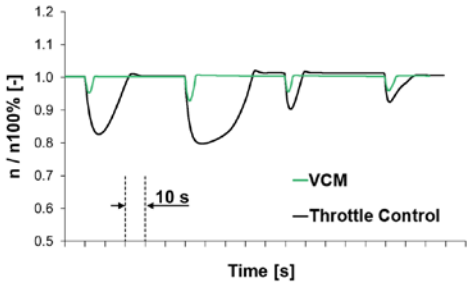
Different valve timing (compared to mechanical valvetrain) → more aggressive Miller

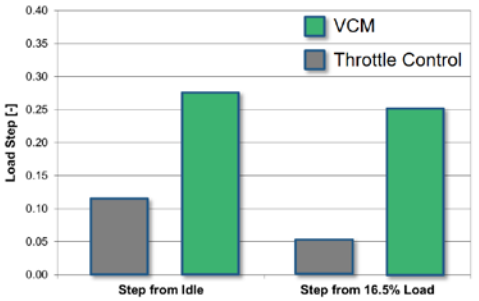
Cooler cylinder cha

Redu

Source: Zelenka J. Expansio

Variable intake valve timing as a key technology
Improved transient response





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CONTACT:

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